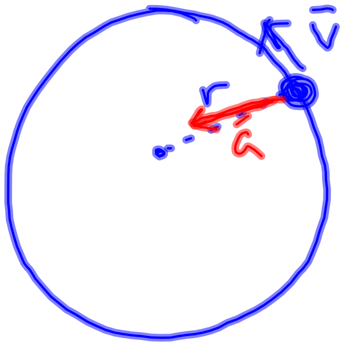
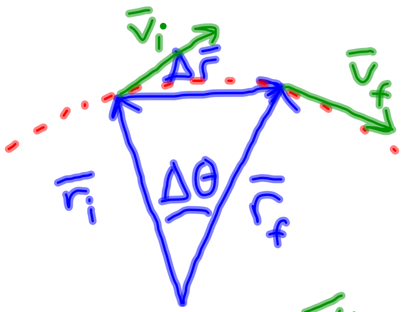
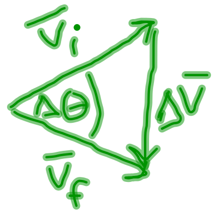
Circular Motion: (Uniform)



a, v, r





$v = v_i = v_f$

$r = r_i = r_f$

$$\frac{|\Delta\bar{v}|}{v} = \frac{|\Delta\bar{r}|}{r}$$

$$|\bar{a}_{avg}| = \frac{|\Delta\bar{v}|}{|\Delta t|} = \frac{v}{r}\,\frac{|\Delta\bar{r}|}{|\Delta t|} \qquad \frac{r}{t} = v$$

$$a_c = \frac{v^2}{r}$$

↳ centripetal acceleration

magnitude only

Vector $\bar{a}_c$ always points radially inward

vector $\bar{a}_c$ always perpindicular to $\bar{v}$

Textbook Sections for this Unit:

4.4

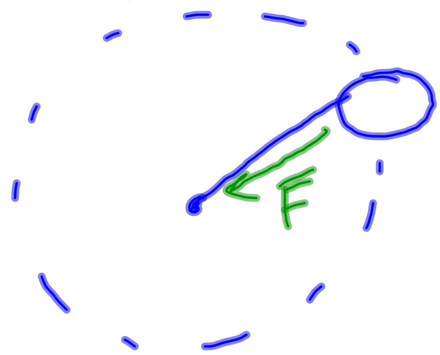
6.1 - 6.3

10.6

13.1 - 13.3

15.1 - 15.5

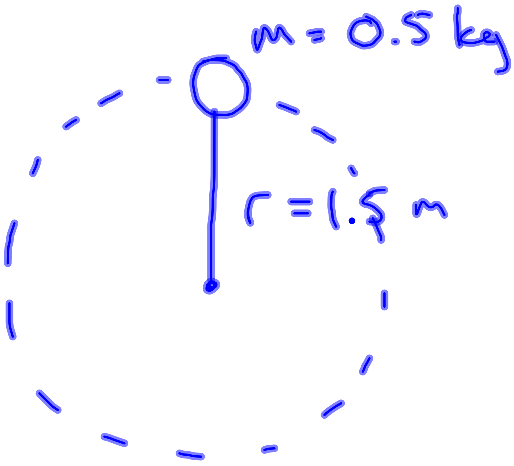
Centripetal acc. related to forces:

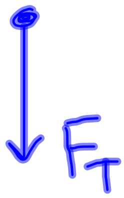


$$\Sigma F = m a_c$$

$$= m \frac{v^2}{r}$$

A ball of mass 0.500 kg is attached to the end of a cord 1.50 m long. The ball is whirled in a horizontal circle. If the cord can withstand a maximum tension of 50.0 N, what is the maximum speed at which the ball can be whirled before the cord breaks? Assume the string remains horizontal during the motion.





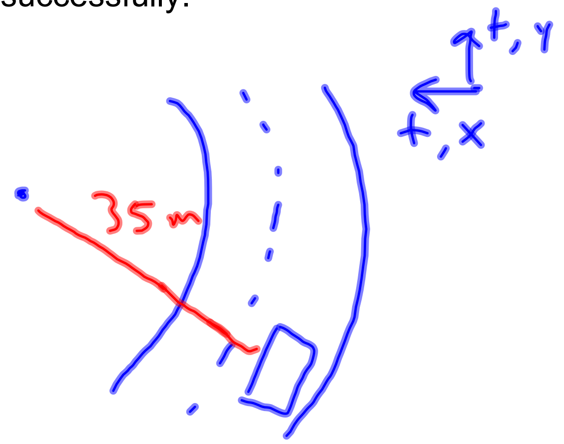
$$\Sigma F = m a_c \qquad a_c = \frac{v^2}{r}$$

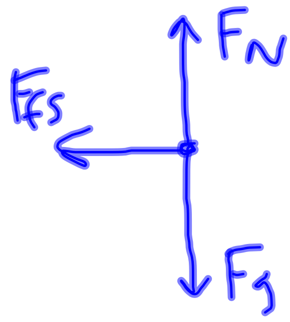
$$F_T = m\frac{v^2}{r}$$

$$v = \sqrt{\frac{F_T r}{m}}$$

$$= 12.3\ \text{m/s}$$

A 1500 kg car moving a flat, horizontal road negotiates a curve. If the radius of the curve is 35.0 m and the coefficient of static friction between the tires and dry pavement is 0.523, find the maximum speed the car can have and still make the turn successfully.





back view of car

$$\Sigma F_y = 0$$

$$F_N = F_g = (1500\,kg)(9.8\,m/s^2) = 14700\,N$$

$$\Sigma F_x = m a_c$$

$$F_{fs} = m\frac{v^2}{r}$$

$$F_{fs} = \mu_s F_N = (.523)(14700\,N) = 7688\,N$$

$$V = \sqrt{\frac{F_{fs}\, r}{m}} = 13.4\,m/s$$

$$(13.4\,m/s)\left(\frac{3600\,s}{1\,h}\right)\left(\frac{1\,km}{1000\,m}\right)\left(\frac{.62\,m}{1\,km}\right) = 30\,mph$$